REMARKS

The Office Action mailed August 11, 2004, has been carefully reviewed and by this Amendment, Applicants have canceled claims 1-10 and added claims 11-30. Claims 11-30 are pending in the application, and claims 11, 16 and 25 are independent.

The Examiner rejected claims 1-10 under 35 U.S.C. 112, second paragraph, as failing to define the invention, and further rejected claims 1-10 under 35 U.S.C. 103(a) as being unpatentable over JP-2001 123438-A to Shiraishi in view of JP-62050510-A to Nojiri.

By this Amendment, Applicant has canceled claim 1-10, rendering the rejections technically moot. However, with respect to new claims 11-30, Applicant provides the following remarks.

As set forth in new claims 11, 16 and 25, the present invention is directed to a method, and a system for performing the method, for preventing seismic liquefaction of ground in a built-up urban area where a loose fine-grained layer vulnerable to seismic liquefaction is underlain with a soft cohesive layer liable to uneven settlement caused by lowering of a groundwater table, and with a deep granular layer underlying the soft cohesive layer. According to the method, pore water is first pumped out of the loose fine-grained layer to lower the groundwater table and thereby

create pore voids in the loose fine-grained layer. The pore water is pressurized and pushed down through the soft cohesive layer into the deep granular layer, preferably on a reciprocal basis with compressed air to prevent clogging at the point where the pore water is injected. The uplift force of the pumped pore water and compressed air counteracts the downward force caused by the lowering of the groundwater table in the loose fine-grained layer.

Once the groundwater table has been lowered and the extracted water pushed into the deep ground layer, a mixture of tap water saturated with dissolved air, micro particles of mineral powder and a diffusing agent is injected into the pore voids in the loose fine-grained layer until they are filled. When this step is completed, an air-mixed zone is formed in which a plurality of the air bubbles dissolved in the tap water make cores of the micro particles of mineral powder and are thereby bubbled out of the mixture (see page 31, lines 5-17). As a result of this bubbling or separating out of the air bubbles due to their clustering around the micro particle cores, the degree of pore water saturation in the loose fine-grained layer is reduced to a level which prevents seismic liquefaction due to earthquake.

As discussed in the specification on page 4, lines 3-9, there are various approaches to preventing seismic liquefaction including those methods directed to lowering the saturation degree of pore water contained in the ground, of which the present invention is one. As further discussed in the specification at pages 6 and 7, however, the prior art methods that are based on lowering ground water levels using deep wells or blowing compressed air into the ground have associated problems and drawbacks that have rendered them unsuitable, particularly when applied to built-up urban areas.

As noted on page 7, lines 1-22, the cited art of Shiraishi is the Applicant's own invention and is identified as having the same drawback as found in the other cited references, namely that when injecting compressed air, the air-mixed zone that is created is limited in its extent due to the concentration of the air bubbles around the source outlet through which the compressed air is released. This concentration or "swarming" or air bubbles prevents the desired expansion of the air-mixed zone necessary to prevent seismic liquefaction of the ground arising from an earthquake.

Nojiri discloses a method by which liquefiable sandy ground is solidified by filling the voids between ground particles

with injected particles of an inorganic substance such as silica stone or kaolin. However, this approach suffers from several drawbacks. The first is similar to the drawback of Shiraishi in that the silica stone or kaolin particles, while "dispersed into the well 3 in a suspended state, the suspension diffused into the groundwater 9 around the well 3 and moved with the groundwater 9 to the direction of the well point 4", tend to clog around the inlet through which they are injected. In application, it is very difficult to make the powdered silica or kaolin penetrate smoothly through the twisted narrow pore voids of the ground as Nojiri suggests. Instead, the particles cluster around the outlet of charge well 3, preventing effective dispersion such that the narrow passages of the pore voids are not filled.

Secondly, it is highly impractical to grind a sufficient amount of "inorganic substance such as silica stone or kaolin" to fill up all of the pore voids in the ground, because silica stone and kaolin are very hard materials and it would be extraordinarily expensive to grind these materials into such micro particles as to be diffused out when mixed with groundwater.

Thirdly, obtaining a sufficient quantity of siliceous sand or kaolinite sand that does not contain any harmful

ingredients so as to be suitable for filling up the pores of natural ground would be very difficult.

In sum, Nojiri's method of filling up pore voids with an inorganic substance is feasible only when applied to a miniature model of ground where no clogging of the pore voids will take place; this is not a realistic scenario and has no application to the prevention of seismic liquefaction in an urban setting by lowering the saturation degree of a loose fine-grained layer as claimed by the present invention.

One of ordinary skill in the art would not combine Nojiri with Shiraishi as stated by the Examiner because Shiraishi teaches the injection of compressed air to lower the saturation degree, while Nojiri attempts to solve the same problem by solidifying the soil. There is nothing in either of these references to suggest that by injecting a mixture of tap water saturated with dissolved air, micro particles of mineral powder and a diffusing agent into pore voids, the presence of the micro particles of mineral powder would create a core material around which the air bubbles would "swarm" resulting in the bubbling out of the dissolved air bubbles which, as stated on page 31, lines 5-11, would otherwise not occur. This is clearly beyond the scope of Shiraishi and Nojiri, and may

only be said to be suggested with the benefit of Applicant's own disclosure which cannot be relied upon for this purpose.

For at least the foregoing reasons, claims 11, 16 and 25 are patentable over the prior art. Favorable consideration and allowance thereof is requested. Claims 12-15, 17-24 and 26-30 are also in condition for allowance as claims properly dependent on an allowable base claim and for the subject matter contained therein.

Accordingly, with this amendment and the foregoing remarks, it is respectfully submitted that the present application is in condition for allowance. Should the Examiner have any questions or comments, the Examiner is cordially invited to telephone the undersigned attorney so that the present application can receive an early Notice of Allowance.

Respectfully submitted,

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Date: February 11, 2005
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